Counting the number of days in a Month-Year Calendar my Algorithm

Dave Ryan T. Cariño
MSU – GSC Alumni, Mathematician

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Abstract

This study is an algorithm of calculating the number of days of the Month-Year for any given Month and Year in Gregorian & Julian calendar using simplified formula. It consists of eleven algebraic (6 for Julian) expression, all of it are integer function by substituting the year and month. This formula will calculate the number of days which gives a number from 28 to 31 that determines the exact number of days in a given Month-Year. This algorithm has no condition even during leap-year and 400-year rule.

1 Introduction

This algorithm is devised using basic mathematics, without any condition or modification to the formula. This algorithm will provide a direct substitution to the formula, without referring to a table.

For any calendar date, m denotes for month and y for year; m is the number of months in the calendar year, i.e., $m = 1$ for the month of January, $m = 2$ for the month of February and $m = 12$ for the last month of the year which is December. Lastly, y is the calendar year in either Gregorian & Julian calendar.

2 The Formula

This formula is for Gregorian calendar.

In original form,

$$my = 31 - \left\lfloor \frac{3}{7}(m+1) \right\rfloor - 2\left\lfloor \frac{(m+8)}{10} \right\rfloor + \left\lfloor \frac{3m}{7} \right\rfloor + 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + 2\left\lfloor \frac{m}{12} \right\rfloor + \left\lfloor \frac{12y+m-2}{48} \right\rfloor - \left\lfloor \left(\frac{1}{25}\right)\left(\frac{12y+m-2}{48}\right) \right\rfloor + \left\lfloor \left(\frac{1}{100}\right)\left(\frac{12y+m-2}{48}\right) \right\rfloor - \left\lfloor \frac{12y+m-3}{48} \right\rfloor + \left\lfloor \left(\frac{1}{25}\right)\left(\frac{12y+m-3}{48}\right) \right\rfloor - \left\lfloor \left(\frac{1}{100}\right)\left(\frac{12y+m-3}{48}\right) \right\rfloor$$

where

- my is the number of days in a Month $-$ Year
- m is the month ($1 =$ January, $2 =$ February, ………, $12 =$ December)
- y is the Gregorian year

3 Simplified formula

In original form,

$$my = 31 - \left\lfloor \frac{3}{7}(m+1) \right\rfloor - 2\left\lfloor \frac{(m+8)}{10} \right\rfloor + \left\lfloor \frac{3m}{7} \right\rfloor + 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + 2\left\lfloor \frac{m}{12} \right\rfloor + \left\lfloor \frac{12y+m-2}{48} \right\rfloor - \left\lfloor \left(\frac{1}{25}\right)\left(\frac{12y+m-2}{48}\right) \right\rfloor + \left\lfloor \left(\frac{1}{100}\right)\left(\frac{12y+m-2}{48}\right) \right\rfloor - \left\lfloor \frac{12y+m-3}{48} \right\rfloor + \left\lfloor \left(\frac{1}{25}\right)\left(\frac{12y+m-3}{48}\right) \right\rfloor - \left\lfloor \left(\frac{1}{100}\right)\left(\frac{12y+m-3}{48}\right) \right\rfloor$$

then,

$$my = 31 - \left\lfloor \frac{3}{7}(m+1) \right\rfloor - 2\left\lfloor \frac{(m+8)}{10} \right\rfloor + \left\lfloor \frac{3m}{7} \right\rfloor + 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + 2\left\lfloor \frac{m}{12} \right\rfloor + \lfloor a \rfloor - \left\lfloor \frac{a}{25} \right\rfloor + \left\lfloor \frac{a}{100} \right\rfloor - \lfloor b \rfloor + \left\lfloor \frac{b}{25} \right\rfloor - \left\lfloor \frac{b}{100} \right\rfloor$$

where

- $a = \frac{(12y+m-2)}{48}$
- $b = \frac{(12y+m-3)}{48}$

4 Examples

Several examples are presented/shown to illustrate the algorithm.

Example 1: November 1582, first full month of Gregorian calendar.

$m = 11, \qquad y = 1582$

$$a = \frac{(12\{1582\}+11-2)}{48} = \frac{18993}{48} = 395.6875$$

$$b = \frac{(12\{1582\}+11-3)}{48} = \frac{18992}{48} = 395.\bar{6}$$

$$\begin{aligned} my &= 31 - \left\lfloor \frac{3}{7}(11+1) \right\rfloor - 2\left\lfloor \frac{(11+8)}{10} \right\rfloor + \left\lfloor \frac{3(11)}{7} \right\rfloor + 2\left\lfloor \frac{(11+7)}{10} \right\rfloor + 2\left\lfloor \frac{11}{12} \right\rfloor + \lfloor 395.6875 \rfloor - \left\lfloor \frac{395.6875}{25} \right\rfloor + \left\lfloor \frac{395.6875}{100} \right\rfloor - \lfloor 395.\bar{6} \rfloor + \left\lfloor \frac{395.\bar{6}}{25} \right\rfloor - \left\lfloor \frac{395.\bar{6}}{100} \right\rfloor \\ &= 31 - \lfloor 5.1429 \rfloor - 2\lfloor 1.9 \rfloor + \lfloor 4.7143 \rfloor + 2\lfloor 1.8 \rfloor + 2\lfloor 0.91\bar{6} \rfloor + \lfloor 395.6875 \rfloor - \lfloor 15.8275 \rfloor + \lfloor 3.9569 \rfloor - \lfloor 395.\bar{6} \rfloor + \lfloor 15.82\bar{6} \rfloor - \lfloor 3.95\bar{6} \rfloor \\ &= 31 - \lfloor 5 \rfloor - 2\lfloor 1 \rfloor + \lfloor 4 \rfloor + 2\lfloor 1 \rfloor + 2\lfloor 0 \rfloor + \lfloor 395 \rfloor - \lfloor 15 \rfloor + \lfloor 3 \rfloor - \lfloor 395 \rfloor + \lfloor 15 \rfloor - \lfloor 3 \rfloor \\ &= 30 \end{aligned}$$

So, November 1582 has 30days

Example 2: February 1900, latest centennial that is not a leap-year

$m = 2, \qquad y = 1900$

$$a = \frac{(12\{1900\} + 2 - 2)}{48} = \frac{22800}{48} = 475$$

$$b = \frac{(12\{1900\} + 2 - 3)}{48} = \frac{22799}{48} = 474.9791\bar{6}$$

$$my = 31 - \left\lfloor \frac{3}{7}(2+1) \right\rfloor - 2\left\lfloor \frac{(2+8)}{10} \right\rfloor + \left\lfloor \frac{3(2)}{7} \right\rfloor + 2\left\lfloor \frac{(2+7)}{10} \right\rfloor + 2\left\lfloor \frac{2}{12} \right\rfloor + \lfloor 475 \rfloor - \left\lfloor \frac{475}{25} \right\rfloor + \left\lfloor \frac{475}{100} \right\rfloor - \lfloor 474.9791\bar{6} \rfloor + \left\lfloor \frac{474.9791\bar{6}}{25} \right\rfloor - \left\lfloor \frac{474.9791\bar{6}}{100} \right\rfloor$$

$$= 31 - \lfloor 1.2857 \rfloor - 2\lfloor 1 \rfloor + \lfloor 0.8571 \rfloor + 2\lfloor 0.9 \rfloor + 2\lfloor 0.1\bar{6} \rfloor + \lfloor 475 \rfloor - \lfloor 19 \rfloor + \lfloor 4.75 \rfloor - \lfloor 474.9791\bar{6} \rfloor + \lfloor 18.9991\bar{6} \rfloor - \lfloor 4.7498 \rfloor$$

$$= 31 - 1 - 2 + 0 + 0 + 0 + 475 - 19 + 4 - 474 + 18 - 4$$

$$= 28$$

So, February 1900 has 28days

5 The Algorithm

- $a = \frac{(12y+m-2)}{48}$
- $b = \frac{(12y+m-3)}{48}$

Gregorian Calendar:

$$my = 31 - \left\lfloor \frac{3}{7}(m+1) \right\rfloor - 2\left\lfloor \frac{(m+8)}{10} \right\rfloor + \left\lfloor \frac{3m}{7} \right\rfloor + 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + 2\left\lfloor \frac{m}{12} \right\rfloor + \lfloor a \rfloor - \left\lfloor \frac{a}{25} \right\rfloor + \left\lfloor \frac{a}{100} \right\rfloor - \lfloor b \rfloor + \left\lfloor \frac{b}{25} \right\rfloor - \left\lfloor \frac{b}{100} \right\rfloor$$

Julian Calendar:

$$my = 31 - \left\lfloor \frac{3}{7}(m+1) \right\rfloor - 2\left\lfloor \frac{(m+8)}{10} \right\rfloor + \left\lfloor \frac{3m}{7} \right\rfloor + 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + 2\left\lfloor \frac{m}{12} \right\rfloor + \lfloor a \rfloor - \lfloor b \rfloor$$

Common year with 365days:

$$my = 31 - \left\lfloor \frac{3}{7}(m+1) \right\rfloor - 2\left\lfloor \frac{(m+8)}{10} \right\rfloor + \left\lfloor \frac{3m}{7} \right\rfloor + 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + 2\left\lfloor \frac{m}{12} \right\rfloor$$

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References

[1] https://en.wikipedia.org/wiki/Gregorian_calendar
[2] https://en.wikipedia.org/wiki/Julian_calendar